International Journal of Advances in Psychology (IJAP) Volume 3 Issue 4, November 2014 www.ij-psychol.org
doi: 10.14355/ijap.2014.0304.05

Students' Free Studying After Training with Instructions about the Mnemonic Benefits of Testing

Do students use the self-testing spontaneously?

Hotta, C., Tajika, H., & Neumann, E.

[*1]Department of Welfare Sciences, Kansai University of Social Welfare, Japan;

[2]Department of Education and Psychology, Kobe Shinwa Women's University, Japan;

[3]Department of Psychology, University of Canterbury, New Zealand

[*1]chie_hotta@yahoo.co.jp; [2]tajika@kobe-shinwa.ac.jp; [3]ewald.neumann@canterbury.ac.nz

Abstract

Testing has a powerful effect on long-term retention. We examined whether training with instructions about the mnemonic benefits of testing could lead to spontaneous use of it during free studying. After studying a short-answer question associated with a selection of prose, some students were given an instruction and training session focusing on the benefits of testing (Instruction+training group), whereas other students were only given an instruction about the benefit of testing (Instruction group). After free studying, students were asked each question immediately and 1 month later. The results showed that students in the instruction+training group spontaneously used self-testing had the best performance on the delayed test, compared to the instruction and no instruction groups. These results suggest that training in addition to instruction is essential to increase the spontaneous use of self-testing.

Keywords

Testing Effect; The Spontaneous Use of Self-testing; Learning Strategy; Metacognitive Awareness; Instruction and Training

Introduction

Research on human learning and memory has demonstrated that repeated testing promotes long-term retention of learning material compared to repeated studying. This phenomenon is called the testing effect (e.g., Gates, 1917; Hogan & Kintsch, 1971; Roediger & Karpicke, 2006). Testing is usually considered as a device for assessing a student's knowledge and aptitude. However, it can be emphasized that testing has a powerful effect on future retention. That is, testing is understood to be a learning strategy in its own right. When students are tested on learning and remembering material successfully, they will retain it more in the future than when they repeatedly study it and are not tested. Typically, the testing effect refers to the findings that an intervening test leads to a better memory performance on a delayed test than restudying the materials for the same amount of time (Hogan & Kintsch, 1971).

Previous studies on the testing effect have been conducted in not only the verbal learning area, but also using educational contexts as materials (e.g., Butler & Roediger, 2007; Kang, McDermott, & Roediger, 2007). For example, Butler and Roediger (2007) presented students three art history video lectures to simulate classroom learning. After the video lectures, students completed a short-answer test or a multiple-choice test, or they read a summary review of the video lecture. One month later, a final test was given. Their results showed that the target facts included in the short-answer test were retained better and that the other two conditions were not different. Johnson and Mayer (2009) examined whether initial testing would enhance transfer to a final test. Participants watched a multimedia slide show about lightning formation. After that, they received a retention test, a transfer test or restudied the slide show. One week later, they took a final test that consisted of both retention and transfer questions. The retention questions asked the participant to write down an explanation of how lightning worked. The transfer questions were such questions as asking what lightning caused. Retention and transfer questions on the final test were the same as those on the initial tests. The results showed that taking an initial transfer test enhanced subsequent transfer learning relative to restudying the slide show. Numerous studies have shown that the testing effect is a verifiable and strong phenomenon.

Despite the mnemonic benefits of testing, research suggests that students lack a metacognitive awareness of the benefits of testing (e.g., Karpicke & Roediger, 2008; Karpicke, Butler, & Roediger, 2009). Karpicke et al. (2009) reported that a majority of students repeatedly read their notes or textbooks, but relatively few engaged in self-testing or retrieval practice while studying by conducting a survey of students' learning strategies.

Considering the little awareness students have that testing has a strong effect on long-term retention, it is highly important that students learn to use spontaneous self-testing as a learning strategy and receive the benefits self-testing in their home learning. However, it is not known how much could be achieved by helping learners to effectively test themselves. So, our aim in the study reported here was to examine whether students would use self-testing repeatedly as their study strategy if they were instructed about the powerful effect it has on performance.

So, we examined whether students would practice testing repeatedly as their learning strategy when they were instructed about the powerful effect it has in an educationally relevant context. To our knowledge, it remains unclear whether simply instructing students about the benefit of testing can lead to helping the majority of students to spontaneously use repeated self-testing. If the majority of students reported little use of self-testing, as would support the findings of Karpicke et al. (2009), it is better to add practical training to the instructions which would inform students about the benefits of self-testing and has such significant mnemonic benefits. Experiencing the use of repeated self-testing would have different effect from hearing simply it on performance and frequency of the use of self-testing. Thus, we examined whether training added to instruction (or instruction only) would lead to the spontaneous use of repeated testing and enhance performance. Furthermore, we investigated the relationship between the strategy used during free studying and recall performance, and tried to gauge the training effect of repeated testing.

Methods

Participants

Ninety university students participated. This experiment was conducted in a group during the lecture. We devided randomly the students into the third part for each of thirty students, the instruction+training group, the instruction group and the control group. All students are first year grade and beginners to learn the topic in our experiment.

Materials

Stimuli used during Instruction and Instruction+ Training session. We used some of the sentences included in the memory test of the Wechsler Adult Intelligence Scale-Revisited (hereinafter WAIS-R) as an examples to explain the testing effect. In addition, students in the instruction+training group were given a booklet with white sheets to practice repeated retrieval.

1) Stimuli Used During Free Learning

All students were given the following materials: (a) a passage associated with an information-processing approach to memory (1,362 words and 7 paragraphs in Japanese); (b) 20 questions and their corresponding answer (Appendix A); (c) short-answer format in 20 questions without the corresponding answer (Appendix B); and (d) a booklet including two sheets of paper for practicing during studying. The reason that we prepared not only the passage of (a), but also the formats of (b) and (c) was that was in preliminary experiment, it is difficult to spot the key things on their own through the passage for undergraduate students in first year grade because they have never heard of the contents in a passage.

2) Immediate and Delayed Test.

All students received the rearranged version of (c), which was used during free learning on the immediate and delayed test conditions.

Design

A 3 (Instruction group: instruction+training vs. instruction vs. control) X 2 (Retention Interval: immediate vs. 1 month later) mixed factorial design was used. The Instruction group condition was manipulated as a between-subject factor and retention interval was a within-subject factor.

Procedure

The procedure in this study consisted of six phases. Figure 1 shows the flow of procedures.

1) The Training Session

We instructed the benefits of repeated testing, compared to repeated reading. First, we instructed the condition of repeated reading. The students in

the instruction+training group were asked to read a passage of the WAIS-R memory test on the screen three times. Next, we instructed the condition of repeated testing. After reading another passage of WAIS-R, the passage was omitted from the screen. They were asked to remember and correctly write as much of the passage as possible on the sheet. They were given feedback and told to reread it. We conducted this repeated self-testing two-times. Thus, the students in the instruction+training group were taken actual practical training.

2) The Instruction Session

We just explained the use of repeated self-testing using the passage, compared to repeated reading. After that, while showing the data of Karpicke & Roediger (2006) on a computer screen to the students in the instruction+training and instruction groups, we lectured that self-testing enhances learning and long-term retention compared to repeated reading. Finally, we asked students to answer "yes or no" whether they understood the mnemonic benefits of self-testing. Hence, students in the instruction+training and instruction groups were given the explanation that there are benefits to self-testing, compared to repeated reading. Students in the control group were not given instructions about the above learning method.

3) The Free Studying Session

First, they were then asked to study a passage associated with an information-processing approach to memory in one of the topics of the psychological class. Then, they were instructed to read a passage at their own pace. Next, they were asked to study freely by using all the materials for 15 minutes. At this time, we instructed that they should study in any way they can. The reason that we added purposely this explanation is as follows. Even if we recommended the use of self-testing in former session, we wanted to exaggerate that decision of use of self-testing was always free to the students in the instruction+training and instruction groups.

4) The Immediate and Delayed Test and Self-Reporting Session

Then, materials were withdrawn and students were asked to write their corresponding answer to each question (e.g., what is the system or systems assumed to underpin the capacity to store information over long periods of time? -----_____). Moreover, we were asked all students the self-reporting in relation to strategy during free studying. If we conducted the self-reporting after the immediate test session, they might forget the detail of the study schedule during free study session. So, we did immediately after first test session. One month later, cue questions on the delayed test were identical to those used on the immediate cued test but were randomly rearranged.

5) Strategy Question

After immediate test, we asked all participants how much self-testing was used during free studying, from 1 (not used) to 5 (always used) points.

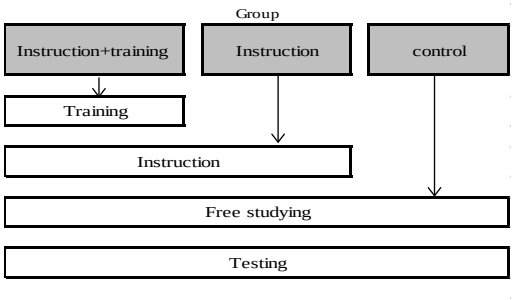

FIGURE 1. FLOW CHART OF THE PROCEDURE IN THIS STUDY

Results and Discussion

All students in the instruction+training and instruction groups could understand the mnemonic benefits of repeated self-testing. Also, as shown in Figure 2, the degree used the self-testing strategies during free studying in the instruction+training groups was higher than those in the instruction ($t(87) = 6.92$, $MSe = 1.25$, $p < .001$, $r = .60$) and control ($t(87) = 5.42$, $MSe = 1.25$, $p < .001$, $r = .50$) groups, whereas there was no difference between the instruion and control groups ($t(87) = 1.5$, $MSe = 1.25$, ns, $r = .16$), $F(2, 87) = 26.54$, $MSe = 1.25$, $p < ..01$, $\eta 2 = .38$. As predicted, these results suggest the weakness for spontaneous use of testing strategy in only instruction of mnemonic benefits of testing.

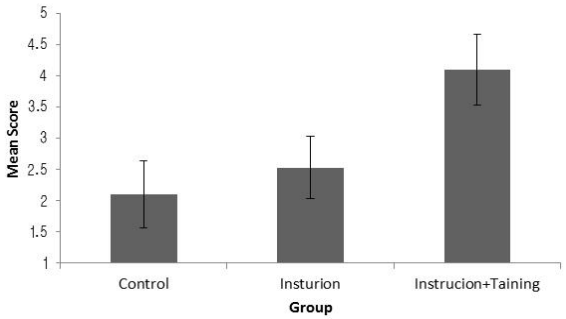

FIGURE 2. THE FREQUENCY OF THE USE OF SELF-TESING DURING FREE STUDYING IN EACH GROUP

As shown in Table 1, recall performance in the immediate condition was better than that in the delayed condition (F (1, 87) = 951.39, MSe = 8.17, p < .001, η2= .87). Overall performance in the control (t (87) = 5.93, MSe = 8.56, p < .001, r = .54) and the instruction (t (87) = 7.61, MSe = 8.56, p < .001, r = .63) groups were less than those of instruction+training group, whereas that of the instruction groups were marginally less than that of the control group (t = 1.69, p < .10, r = .18.), F (2, 408) = 24.11, MSe = 15.55, p < .001). Especially this trend exaggerated for immediatecondition (F (2, 174) = 23.53, MSe = 8.37, p < .001, partialη2= .21). In the immediate condition, the performance in the instruction+training (t (174) = 6.83, MSe = 8.37, p < .01, r = .46) and control (t (174) = 3.97, MSe = 8.37, p < .01, r = .29) groups was better than that in the only instruction group, and further that in the control group was better than that in the instruction group (t (174) = 2.86, MSe = 8.37, p < .01, r = .21). The other hand, more importantly, in the delayed condition (F (2, 174) = 12.34, MSe = 8.37, p < .001, partialη2= .12), performance in the instruction+training group was better than that in the instruction (t (174) = 4.06, MSe = 8.37, p < .01, r = .30) and control (t (174) = 4.51, MSe = 8.37, p < .01, r = .32) groups, whereas that in the instruction and control groups did not differ (t (174) = .05, ns, r = .04). This selective modulation reflected a significant interaction of Instruction and Retention Interval (F (2, 87) = 3.22, MSe = 8.17, p < .05, η2= .01).

TABLE 1 MEAN PROPORTION OF WORDS RECALLED AS A FUNCTION OF GROUP AND RETENTION INTERVAL

	Control	Instruction	Instruction+Training
Immediate	.79 (.21)	.69 (.22)	.94 (.11)
Delayed	.09 (.07)	.10 (.06)	.25 (.10)

Note). Parentheses are standard deviation.

To summarize, the training added to the instruction for the benefits of self-testing could lead to promoting the long-term retention, although it was enough to only instruct the benefits of testing. More importantly, there were significant defference between inirrespective of proportion of the particitpants used self-testing in the insturion+training group was nearly identical to those in the instruction group.

General Discussion

We examined whether giving students instructions about the benefits of self-testing and training them to use self-testing resulted in better performance. When we instructed students about the benefits of self-testing, using practical training and repeated testing, they enhanced the performance, especially in the delayed test. Thus, the training added to instruction of benefits of testing had effect on the typical testing effect. It is important to obtain typical testing effect under the condition of high ecological value.

This study provided the below unique results. Taking a test during free studying had a beneficial effect on memory not only one month later, but also immediately, particularly in the instruction+training group. Previous research has shown that intervening testing leads to a better memory performance on a delayed test, but not on an immediate one. Also, the influence of an intervening test on an immediate test typically worsened performance compared with that of rereading (e.g., Hogan & Kintch, 1971; Karpicke & Roediger, 2008). This dissociation between previous research and this study seems to be due to the mixed use of repeated self-testing and rereading during free studying. Many basic laboratory studies use the restricted design of massed testing after reading, whereas this study wanted to know the effect of the spontaneous use of self-testing on performance and students' competence using it under conditions closer to an educational context. Basically, this study supports the findings of previous studies.

However, we must interpret a strange result that the instruction of testing cause less performance in immediate test, compared to no instruction. Before that, we need to keep in mind that these complex results were obtained because we examined the training effect in ecological framework but not strict learning condition. First possibility is that, originally, the students in the control group might motivate highly to do the learning of material in this study, whereas that in the instruction group might not so. However, we cannot confirm this possibility because we did not ask them their attitude toward learning.

Second, the students in the control group might have the constant use of self-testing, whereas that in the instruction group might not regularly use the self-testing during free studying. Karpicke (2009) reported that students' judgments of learning seemed to rely on retrieval fluency and the use of self-testing would fatigue them because they must continue retrieving to-be-remembered information without the feedback given. Especially, the students in the instruction group might expect the dramatic enhancement effect by using the self-testing, whereas they might feel like to go wrong contrary to their expectation during free studying. Even if they just knew self-testing as a

strategy, they eventually might try to shift from self-testing to another learning strategy (e.g., "repeated writing" or "doing problem solving" in the presense of the material) in order to avoid the low frequency. Similar to the first possibility, we cannot confirm this possibility.

This study raises important issues. Testing participants one month later might not be appropriate for the delayed test due to the performance level suffering from floor effects in the delayed test (cf. Larsen, Butler, & Roediger, 2009). In a future study, we would use a shorter retention interval. Moreover, we need to develop more methods for promoting further spontaneous use of self-testing. Of course, as indicated in many previous studies of the testing effect (e.g., Roediger & Karpicke, 2006a, for a review; Roediger & Karpicke, 2006b), better performance was ultimately obtained with self-testing.

Even if they understood the mnemonic benefits of self-testing, they could not always use it. Their reports suggest that they may be tempted to mistakenly attribute the fluency of performance during studying for effective training in the long run (e.g., Karpicke et al., 2009; Koriat & Bjrok, 2005). The results of this study suggest we need to consider not only the lack of metacognitive knowledge, but also the lack of metacognitive activity, which means that even if they have received the message that self-testing is an effective strategy, The training is necessary for the spontaneous use of it. Hence, we need to find clever methods for encouraging more students to self-test to-be-learned material, and repeatedly use self-testing in their learning strategy repertoire.

REFERENCES

Butler, Andrew.C., & Roediger ,Henry.L. Testing improves long-term retention in a simulated classroom setting. European Journal of Cognitive Psychology, 19, 514-527. 2007.

Gates, Arthur.I. Recitation as a factor in memorizing. Archives of Psychology, 6 (40). 1917.

Hogan, Robert.M., & Kintsch, Walter. Differential effects of study and test trials on long-term recognition and recall. Journal of Verbal Learning and Verbal Behavior, 10, 562-567. 1971

Johnson, Cheryl.I., & Mayer, Richard.E. A testing effect with multimedia learning. Journal of Educational Psychology, 101, 621-629. 2009

Kang, Sean. H. K., McDermott, Kathleen. B., & Roediger, Henry. L. Test format and corrective feedback modulate the effect of testing on memory retention. The European Journal of Cognitive Psychology, 19, 528-558. 2007.

Karpicke, Jeffery. D. Metacognitive control and strategy selection: Deciding to practice retrieval during learning. Journal of Experimental Psychology: General, 138, 469-486. 2009.

Karpicke, Jeffery.D., & Butler, Andrew.C., & Roediger, Henry.L. Metacognitive strategies in student learning: Do students practise retrieval when they study on their own? Memory, 17, 471-479. 2009.

Karpicke, Jeffery. D., & Roediger, Henry. L. The critical importance of retrieval for l earning. Science, 319, 966-968.2008.

Koriat, Asher., & Bjork, Robert. A. Illusions of competence in monitoring one's knowledge during study. Journal of Experimental Psychology: Learning, Memory, and Cognition, 31, 187-194.2005.

Larsen, Douglas. P., Butler, Andrew. C., & Roediger, Henry. L. Repeated testing improves long-term retention relative to repeated study: a randomized controlled trial. Medical Education, 43, 1174-1181.2009.

Roediger, Henry. L., & Karpicke, Jeffery. D. The power of testing memory: Basic research and implications for educational practice. Perspectives on Psychological Science, 1, 181-210.2006a

Roediger, Henry. L., & Karpicke, Jeffery. D. Test enhanced learning: Taking memory tests improves long-term retention. Psychological Science, 17, 249-255.2006b.